SUPPLY AND SANITATION: SERVING THE URBAN UNSERVED

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INTRODUCTION

During the last century, water consumption has increased at a rate more than twice the population. It is estimated that 884 million people, 13% of the world's population, currently lack access to improved drinking water and 2,600 million people, 39% of the world's population, does not have adequate sanitation facilities. ["Joint Monitoring Programme for Water Supply and Sanitation. Progress on water and sanitation: 2010 Up date. "UNICEF, New York and WHO, Geneva, 2010].

By 2020, 60% of the world population will be urban, a concentration that makes the development of infrastructure for water supply in cities an extremely urgent issue. These factors, which influence the world's water resources, are all interrelated and cannot be treated separately, which further complicates analysis of the situation ["Water for the Future: What are the trends?", UNESCO, 2003].

It is estimated that by 2030, two thirds of the population will live in towns and cities, which will cause a dramatic increase in water demand in urban areas. An estimated 2,000 million people live in squatter settlements and slums. This segment of the urban population suffers from lack of clean water and sanitation facilities ["Water, a shared responsibility. Second United Nations report on the development of water resources in the world ", 2006].

Daily water consumption varies between 200 and 300 liters per person in most European countries and 575 liters in the United States. By contrast, the average use in countries such as Mozambique is less than 10 liters. People who lack access to piped water in developing countries consume less water, in part, because they have to travel long distances with it and water is heavy.

The international standards set by organizations like the World Health Organization (WHO) and the United Nations Fund for Children (UNICEF) suggest a minimum consumption of 20

liters a day from a source within one kilometer of home. This is enough for drinking and basic personal hygiene. People who are unable to gain access to this amount of water are limited in their ability to maintain physical well-being and dignity that cleanliness provides. If water needs for bathing and washing are considered, the amount per person increases to about 50 liters per day. Much of the world's population is well below the minimum thresholds for basic water needs. There are approximately 1,100 million people who live within a mile of a water source and use less than five liters of water daily that is not safe. ["Human Development Report 2006. Beyond scarcity: Power, poverty and the global water crisis" Published for the United Nations Programme for Development (UNDP)].

A report on Latin America by ADERASA for 32 companies that provide drinking water to the region found that the average sold or consumed water was 171 liters/capita/day, with a maximum of 400 liters/capita/day (Buenos Aires and Panama) and a minimum of 104 liters/capita/day. It should be noted that such use does not take into account the net loss of water released (on average 44%). Hence, the daily per capita output is 389 l/h/day.

In Argentina, the national average production per capita water provided is estimated at 380 l/person/day, with a wide range of variation between different provinces, from a maximum of 654 l/person/day in the Province of San Juan and a minimum of 168 l/person/day in the Province of La Pampa. The level of unaccounted-for water is one of the main problems of efficiency in water services. It is estimated that 40% of the water produced is lost in the network and through illegal connections. The average water consumption in Argentina is on the order of 230 liters/capita/day. Moreover, it is estimated that the real average consumption, based on the results of operating systems with micro measurement, is on the order of 180 l/person/day [PAHO, 1999].

WATER AND SANITATION COVERAGE

It is estimated that in 2008, 87% of the world's population used improved drinking water sources -- 57% with a pipe connection in the home, plot or yard, and 30% with other drinking water sources. This means that 5,900 million people worldwide were using an improved source of drinking water, an increase of 1,900 million since 1990. Approximately 3, million people use a pipe connection that provides running water in their homes or nearby.

With regard to sanitation, an estimated 61% of the world's population had access to improved sanitation (i.e. a hygienic manner ensuring no contact between people and human excrement). Eleven percent share an improved sanitation installation with one or more houses and another 11% use unimproved sanitation facilities (i.e. does not guarantee no contact between people and human excrement. The remaining 17% of the world's population practice open defecation. This value indicates that the coverage of sanitation in the developing world increased from 41% in 1990 to 54% in 2008. About 1,100 million people in developing nations have incorporated improved sanitation facilities in that period. ["2006 Human Development Report developed" UNDP, and "Joint Monitoring Programme for Water Supply and Sanitation. Progress on water and sanitation: 2010 Up date" UNICEF, New York and WHO, Geneva, 2010]. Many specialized studies have identified the crisis in water and sanitation as a crisis of poverty. More than two-thirds of people without access to clean water survive on less than two dollars a day -- and one in three on less than one dollar a day. More than 660 million people without adequate sanitation live on less than two dollars per day and less than 385 million on less than a dollar a day. This clearly shows the serious problems in funding improvements in water and sanitation services. [World Water Assessment2009.The United Nations World Water Development Report 3: Water in a Changing World. Paris: UNESCO and London: Earthscan.] Table No. 1 shows the percentage of population covered with water and sanitation services by region. Sub-Saharan Africa is has the least urban household water supply, followed by Southern and South Eastern Asia. Urban sanitation is similar

Region	Urban water - piped on permises	Urban Water	Urban Sanitation
Eastern Asia	96	98	61
South Eastern Asia	52	92	79
Southern Asia	51	95	57
Western Asia	93	96	94
Sub-Saharan Africa	35	83	44
North Africa	91	95	94
Developed countries	98	100	100
Latin America and the Caribbean	92	97	86

Table 1: Percentage of population covered with water and sanitation by region. Source: WHO/UNICEF (2010).

The lack of potable water supply and sanitation has grown on the international agenda in recent years. In September 2000 at the Millennium Summit of the United Nations, under Objective No. 7 Ensure environmental sustainability, the goal was stated to reduce by half the proportion of people without sustainable access to safe drinking water by 2015. At the Johannesburg Summit (August 26 to September 4, 2002), this commitment was reaffirmed by adding a line to the previous goal: halving by the same year the proportion of people without access to sanitation.

To achieve the 2015 target only in Africa, Asia, Latin America and the Caribbean, 2,200 million people will need access to sanitation and 1,500 billion will need access to water before that date. In practice, this would have meant providing water supply services to 280,000 people and sanitation to 384,000 people every day for 15 years ["Report on the Global Water Supply and Sanitation in 2000," Joint WHO / UNICEF Monitoring Water Supply and Sanitation].

Financial resources for water are stagnating. In recent years the average total Official Development Assistance (ODA) for the water sector was around 3,000 million dollars annually, to which was added an additional 1,500 million dollars in the form of non-concessional loans, supplied mainly by the World Bank. However, only a very small proportion of that money (12%) goes to the interests of the needy, and only 10% goes to finance the development of policies, plans and programs relating to water. Additionally, private investment in the services of water supply and sanitation has declined ["Water, a shared responsibility. Second United Nations report on the development of water resources in the world ", 2006].

In Latin America and the Caribbean, according to estimates at the regional level WHO/UNICEF (2010), 97% of the urban population had access to improved water supply in 2008 (95% in 1990) and 86% to sanitation (81% in 1990). Of the rural population, only 80% (63% in 1990) had services available for water supply and 55% (39% in 1990) for sanitation services. During that period, 926 million urban dwellers gained access to improved drinking water sources. At the same time, the urban population without improved drinking water sources increased from 107 million to 137 million. Most of these increases occurred in urban areas in the developing world. Note that of the population with access to drinking water, two

thirds are connected to water main service within the home, while the remaining one third used other sources outside the home (e.g. public tap) and are not in contact with pollution.

Rapid population growth in urban areas represents a growing problem: the number of urban dwellers using improved sanitation has increased by 779 million since 1990, but has not kept pace with urban population growth of 956 million. According to a survey conducted in 2008 by UNICEF/WHO, in developing countries in 2008, 16% of total population lack access to clean water, and 48% do not have adequate sanitation [World Health Organization and United Nations Children's Fund Joint Monitoring Programme for Water Supply and Sanitation (JMP) : 2010 Up date. UNICEF, New York and WHO, Geneva, 2010].

The challenge posed by the current situation is even greater when one considers that, by 2010, due to rapid population growth, the deficit in coverage was projected to increase by about 77 million people, almost all in urban areas [CEPAL/CELADE, 1999]. It should be noted that “improved sanitation” facilities to ensure hygienic separation of excreta includes not only the connection to the sewerage system but also septic tanks, latrines, etc.

Figure 1 shows data from the urban coverage of piped water through household connections for each of the countries of the region for the years 1990 and 2004, according to statistics released by the World Health Organization (2006). This coverage is defined as the percentage of the total urban population that has water service inside the house or on the property. The WHO has published coverage data for water and sanitation improved for 2006 (World Health Organization and United Nations Children's Fund Joint Monitoring Programme for Water Supply and Sanitation (JMP). Progress on Drinking Water and Sanitation: Special Focus on Sanitation. UNICEF, New York and WHO, Geneva, 2008). But improved sanitation information was not broken down as a percentage of population with household connections. Therefore no comparison can be made consistent with the 1990 data. Note that in the document WHO warns of this problem.

According to the information provided by the World Health Organization, the statistics are based on various international surveys and national censuses. The methodologies used in the censuses of different countries may vary, generating heterogeneity between data.

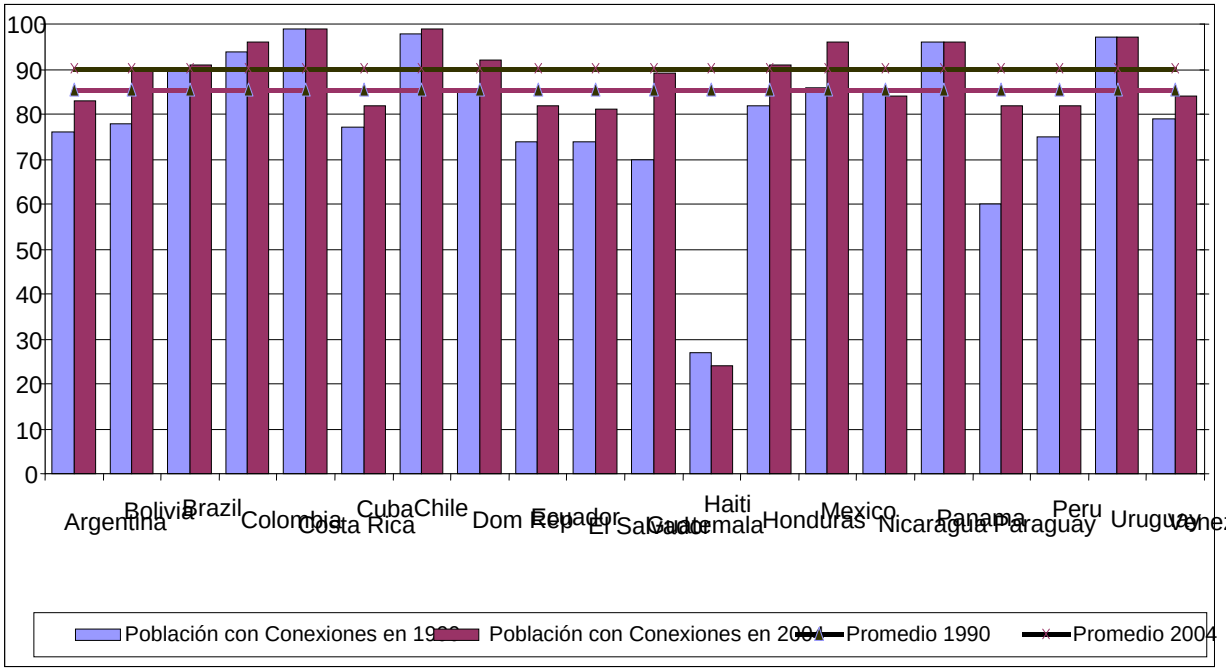

Figure 1. Evolution of the percentage of population with access to drinking water through household connections between 1990 and 2004. Source: WHO/UNICEF: World Health Organization and United Nations Fund for Children: Joint Monitoring Programme for Water Supply and Sanitation.

By 2004 that average increased to 90.2%. Countries exceeding that level of coverage of water per connection were Brazil (91%), Colombia (96%), Costa Rica (99%), Chile (99%), Dominican Republic (92%), Honduras (91%), Mexico (96%), Panama (96%) and Uruguay (97%). This increase of 4.7 percentage points in the coverage of water service connection means more than 114 million people accessed service in that period. Other countries that increased their coverage, albeit by lesser amounts were Paraguay, Guatemala, Bolivia and Mexico.

With regard to sewer service, Figure 2 shows the percentage of urban population with access to sewer service through a household connection.

Around 1990 the weighted average of the urban population connected to the sewerage system was 57%. Of the countries surveyed, six were over the average: Colombia (89%), Chile (90%), Mexico (66%), Panama (58%), Uruguay (57%) and Venezuela (67%).

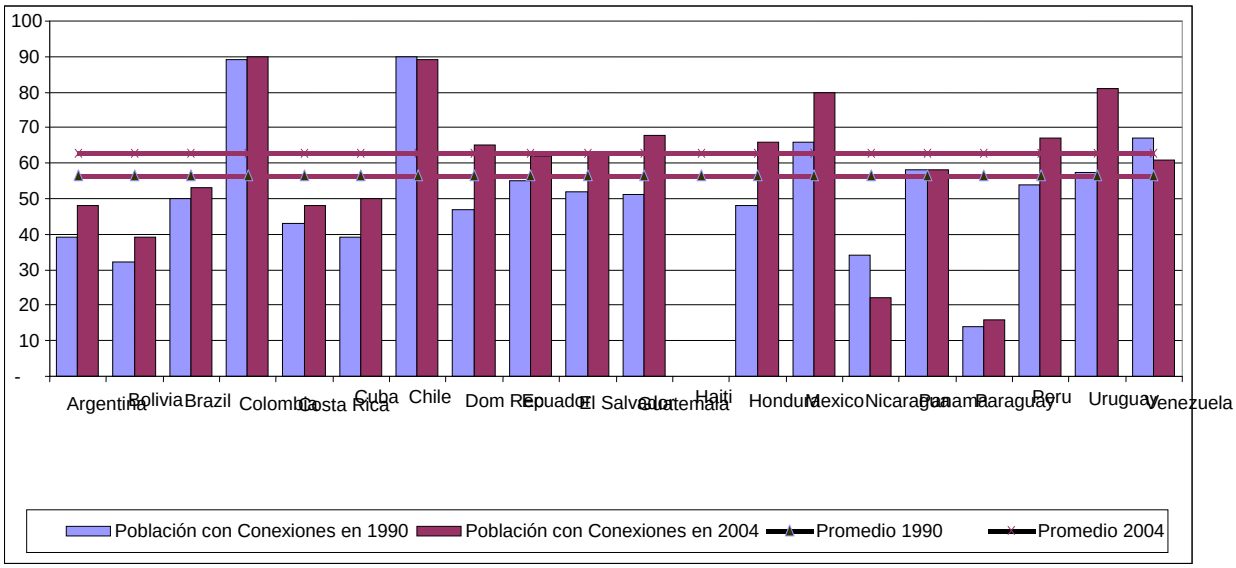

Figure 2. Evolution of the percentage of population with sewerage services through household connections between 1990 and 2004. Source: WHO/UNICEF: World Health Organization and United Nations Fund for Children: Joint Monitoring Programme for Water Supply and Sanitation.

For 2004, the average coverage of all countries is 63%, a 6% increase over 1990. In terms of population, this represents the incorporation of nearly 89 million people to the sewer service. Countries that are above average: Colombia (90%), Chile (89%), Dominican Republic (65%), Guatemala (68%), Honduras (66%), Mexico (80%), Peru (67%) and Uruguay (81%).

The experience of most companies in the region indicates that the high levels of unaccounted-for water arise from deficiencies in business management, primarily billing issues, collection of payments and inadequate policies on overdue accounts, and a high percentage of leakage losses in distribution systems. The population covered with adequate monitoring systems and quality control for drinking water is very limited in urban areas: only 24% of the urban population in the region has effective systems for monitoring the quality of drinking water [PAHO/WHO, 2001]. It is estimated that in large cities in the region, 94% of the drinking water is disinfected effectively, but almost 18% of the samples violated national standards with regard to their microbiological, chemical, physical and aesthetic properties [WHO/UNICEF, 2000]. The lack of coverage and poor quality of service is further complicated by increasing water pollution that has reached alarming levels in many water bodies, mainly due to the widespread lack of wastewater treatment. It is estimated that

currently only 14% of the wastewater collected by sewerage systems receive some degree of treatment [PAHO / WHO, 2001].

By 2004 an estimated 28% of collected wastewater in the region, on average, was treated. In Latin America the highest rates of coverage is for drinking water service, then sewerage services and, finally, treatment of effluents. This suggests an evolutionary process whereby industry first extends coverage of potable water and sewage. Then, finally, it advances in the treatment of effluents.

While the degree of coverage is an indicator of service performance in a given region, it is not the only one. In the case of sewer service, a very important determinant of its development is the treatment of wastewater collected. [Lentini, E., "Drinking Water and sanitation: lessons from relevant experiences, 2009, ECLAC, forthcoming].

In Argentina, both the levels of potable water and sanitation show large regional and provincial disparities between urban and rural areas. The tables presented below show the evolution of coverage in water supply and sanitation in Argentina for the period 1990-2004. Figures for potable water service coverage show that through house connections increased 10% in the last 15 years. This increased coverage partially reflects other types of household connections. In the case of sewer service, it is noted that coverage through household connections has remained steady over the past 15 years. This implies that the coverage has been growing with the population, while the population without coverage has dropped for other types of connections. According to INDEC (National Statistic Center of Argentina), in the last quarter of 2006 (EPH - IV Quarter 2006, INDEC) the coverage of the 32 urban agglomerates (70% of the national urban population) had an average 96% network access to drinking water. Sanitation coverage reached 68% of the population.

Table 2 shows that the lowest coverage of potable water service is in the area of Gran Buenos Aires (73%). While home sanitation service in Gran Buenos Aires has a low value (52%), the lowest value is recorded in Córdoba (35%).

	Drinking Water	Sanitation
Argentina (total country)	96%	68%
Main cities		
Gran Buenos Aires	73%	52%
Córdoba	96%	35%
Rosario	99%	61%
Mendoza	96%	80%
La Plata	92%	68%

Table 2: Coverage of urban drinking water in Argentina. Source: INDEC-EPH Fourth Quarter 2006

Historically, the provision of sanitation has been lower than coverage for the drinking water network. This gap between potable water and sanitation has been varied and emerges in a comparison of the districts. The way to measure this is through the ratio of water users for each user of sanitation services, where the most expresses the greatest asymmetry.

Marginal urban areas present difficulties associated with the expansion of potable water, collection and disposal of effluents, as well as the improvement of intermittent supplies and disinfection. Rural areas require the extension of coverage and implementation of measures and technologies for water disinfection [PAHO, 1998].

Regarding the treatment of wastewater, it is estimated that the country processes only about 12% of the total liquid collected. In a set of 10 provinces between 50% and 85% of total wastewater is treated. In the country's largest cities, treatment is usually limited to no more than 10%.

ORGANIZATION OF THE PROVISION

The current distribution of water and sewer service is similar in structure to that of the country -- each province sets its own jurisdictional rules. Consequently, each province makes its own institutional decisions in the areas of water and wastewater. Each has its own regulatory framework, typically structured in a regulatory agency, and a private operator or the state providing local urban services in the provinces. In several cases with small suppliers, usually in small towns, the structure of the organization is by the state.

The facilities for drinking water in Argentina emerged as a preventive action by the state to

address the cholera epidemics that ravaged the city of Buenos Aires in the late 19th century. Over three quarters of a century, the company OSN (Obras Sanitarias de la Nación) was the sole body responsible for the operation, design and construction of these facilities. Since the early 20th century, the evolution of water and sewer service in Argentina can be distinguished by four stages.

During the first phase, from 1912 to 1980, investment and service delivery were the responsibility of the federal government through a company called Obras Sanitarias de la Nación (OSN). In 1964 a new organization, SNAP (Servicio Nacional de Agua Potable), was created to finance and facilitate the expansion of services in rural areas. This was the beginning of a series of programs funded by the Inter-American Development Bank and financial support for the nation and the provinces. It also laid the groundwork for the formation of 1,500 cooperatives to take charge of the service in small and medium towns.

The second stage began in 1980 when the National Government Services OSN decentralized and transferred to the provinces. The assets were transferred free of debt or charges, but with the obligation for companies to find a new economic formula to cover operating expenses and for investments in renovation and service expansion.

The third stage began with the state reform program in 1989-90 and was characterized by widespread transformation in the organization of public services. This was based on the incorporation of private companies in the administration of services, mainly in large cities, which until then were operated by companies and public institutions. The organizational structure was completed with the formulation of standards established in a regulatory framework and the creation of specialized agencies and autonomous regulation and control over the provision of services. Moreover, government established the National Board of Water and Sanitation Works (ENHOSA), which has jurisdiction throughout the country and whose mission is to organize, manage and implement infrastructure programs resulting from national policies and water sector basic sanitation.

The first grant to a private company was in the province of Corrientes in 1991, when services were delegated to Aguas Corrientes SA. However, the concession was signed with a higher profile in 1993 for the Buenos Aires metropolitan area with the consortium called Aguas Argentinas SA, led by the French firm Lyonnaise des Eaux–Suez.. During the period from 1991 to 2000, about 20 services were privatized in Argentina, including major cities such as Santa Fe and Rosario (Santa Fe Provincial Water SA), Cordoba (Cordoba SA Water), La

Plata and Bahía Blanca (Azurix SA), Tucumán (Aguas del Aconquija SA), Salta and Corrientes.

This model showed its first crisis with some failed processes. Concession contracts were terminated in 1997 in Tucuman and in 2002 in the Province of Buenos Aires. In both cases services were returned to the state.

The fourth stage, characterized by the nationalization of services, occurred after a macroeconomic crisis and the devaluation of 2002 brought a widespread process of renegotiating contracts. Later, contracts were terminated with Aguas de Santa Fe Provincial (2005), Aguas Argentinas SA, Buenos Aires (2006), Aguas de Buenos Aires SA-Suburbs of the City of Buenos Aires (2006), Aguas de Catamarca (2008), Aguas de Salta (2009) and Obras Sanitarias de Mendoza (2009). Thus, private water companies in Argentina went from having a stake of about 70% of the users connected to the drinking water network in the mid-1990s to 30% today. It is important to note that participation was only 13% before privatization, mainly due to the presence of cooperatives and neighborhood associations. It is estimated that currently there are 1,589 providers of water services, of which around 350 provide sewer services. Table N ° 3 shows the classification by legal nature of the provider and the level of decision or jurisdiction.

	Type of provider	National level	Provincial	Municipal	Total
Públic	Limited Company	1	7	0	8
	State Society	0	3	2	5
	Autarkic Entity	0	1	10	11
	Centralized Entity	0	4	455	459
Private	Limited Company	0	6	9	15
	Cooperative	0	0	749	749
	Neighborhood Association	0	0	342	342
	TOTAL	**1**	**21**	**1567**	**1589**

Table Nº 3: Providers of urban drinking water in Argentina. Source: Lentini' calculations based on Spides-ENOHSA.

In this context, on March 21, 2006 the company Argentinos SA Water and Sanitation (AYSA) was established to cover an area of 18,000 km2, a densely populated urban area with 10 million inhabitants, including the city of Buenos Aires metropolitan area and 17 matches Buenos Aires. The population supplied with drinking water is 7,850,000

inhabitants, with more than 4,000,000 m3 of surface water from three water treatment plants and more than 200,000 m3 of groundwater from more than 250 wells. The length of the network of water distribution is on the order of 17,000 km. With regard to sewage, 5,700,000 inhabitants are served with four treatment plants, 89 pumping stations and a nearly 10,000 km long network.

URBAN SERVICE QUALITY

In many countries of the region, levels of service coverage are not sufficient to assess the true state of development of sanitation. The level of service coverage is measured by the amount of network connection or access to any benefit. However, in the case of water, service may be continuous yet only provide several hours a day or rationing may occur for some time during the year. The quality of the water supply also may not meet minimum parameters required by health standards or the food code (such as color, taste, or smell, and chemical, biological or, in a few cases, radioactive contaminants). There are also problems of continuity and network losses. Water quality conditions are usually met at the exit of plants or wells, but deteriorate in transport and distribution, and therefore, the domestic supply is inadequate. In the case of sewerage services, the networks also may lack skills to prevent blockages or overflows.

For this reason, it is important to know through some indicators the quality of provision in order to determine the population's degree of satisfaction with services provided. Potable water services in many countries of the region suffer from a lack of continuity. At the beginning of this century, it is estimated that more than 200 million people about 60% of the population served through house connections to water, were served by systems with intermittent problems (PAHO, 2001). And there were countries in which more than 95% of the supply systems were discontinuous (PAHO, 2001).

Many countries in the region are deficient in drinking water quality control systems. At the turn of the century, it was estimated that only 24% of the urban population of the region had effective control systems for drinking water quality (PAHO, 2001b). In large cities in the region, 94% of the drinking water is disinfected effectively, but almost 18% of the samples violated national standards (WHO/UNICEF, 2000).

Continuity is an important factor to take into account when determining the status of a service due to low values of this indicator. Some customers are induced to use alternative sources or use household drinking water reserves. Metering performed by the operator needs a continuous flow for the proper functioning of meters. Therefore, an area served can have

100% coverage, but programmed cuts to ensure a minimum of pressure to parts of the area reduce the quality of service.

This is especially relevant for continuity in Peru, where the average was 17 hours a day by 2004. Thirty-seven percent of service companies (EPS) provide a continuum of less than 12 hours, 37% between 12 and 20 hours and 26% more than 20 hours. That is, 74% of EPS presented problems of continuity in the provision of water service, some of which offered the service on average four hours per day ("National Plans of Housing and Sanitation from 2006 to 2015" prepared by Ministry Housing, Construction and Sanitation, Peru, March, 2006).

In Colombia, according to World Bank (World Bank, 2004, Recent Economic Development in Infrastructure (REDI) in Colombia, p. 21), the national inventory did not report information on the continuity of service, but advance work in 1996 by the Comptroller General Republic showed a continuity of less than 12 hours a day in four of 21 departmental capitals.

As an alternative way to approximate the continuity of service, the Association of Regulators of the Americas (ADERASA, 2009 Report on 2007 data) developed an indicator called "density of water service cuts." This is the percentage of water connections that have been affected by water cuts of more than six hours in a period of one year. For a sample of 13 companies, ADERASA (2009) finds that the density of cuts is between 1%, in the case of COMPESA (Brazil), and 206% for the case of ESSAL (Chile). Three other companies have values higher than 100%. The latter value implies that the number of connections affected within one year of service cuts is equal to the number of total connections. On average, each connection was cut more than six hours in a year.

Information on the level of quality of drinking water supplied and sewage collected is contained in the benchmarking of companies from countries in the region made by ADERASA (2009). While this study does not provide complete information to perform a comparable analysis by country, some trends can be seen in the most important companies providing various countries. The information excerpted from that report refers to the following indicators:

- Overall implementation of drinking water analysis
- Implementation of wastewater analysis
- Overall Compliance with drinking water analysis
- General conformity with the analysis of wastewater
- Density of total claims

"Overall implementation of drinking water analysis" is defined as the amount of potable water analysis carried out in an annual period, compared to the amount required by applicable law. On a sample of 23 companies, it is noted that 22 of them meet at least 100% of the tests required by the applicable rules, while two companies do not. This indicator needs to be interpreted with caution as an over-compliance to the requirements may mean that water quality is bad and this creates the need for increased controls, or that water quality is good but the penalties for finding values below the standard is high, or that the monitoring plan is inadequate. The same also happens in the sewer service for the indicator of "Running wastewater analysis." For this last indicator on a sample of 19 companies, five do not meet 100% of the tests required by applicable law. For this reason, both indicators should be interpreted in conjunction with the indicators of "general conformity analysis" (i.e. those whose results meet the required standards).

"General conformity analysis of drinking water quality" is the total amount of drinking water testing results in relation to all the tests carried out in the annual period considered. About 22 observations for the year 2007 found that 9 of the companies provided 100% satisfaction with the required standard, while 8 of the remaining on or below the average of 93%. As was the case for drinking water, ADERASA (2009) produced an index of "general conformity analysis of sewage" (defined similarly). A sample of 19 companies shows that eight met 100% compliance with current regulations, while seven of the remaining was below the average of 92%. Both potable water and sewage can be an indicator of quality in service provision. However, nothing guarantees that the policy be uniform throughout the region. This means that a country with lower quality standards can satisfy those standards with higher probability.

Finally, a way of measuring the quality of service can be made by users' perception through the many claims made. In this sense, ADERASA developed an index of "density of total claims," which computes all claims received by a provider during the annual period and is reported as a percentage of total accounts for water and wastewater. The average for the sample of 41 observations by ADERASA (2009) was 16%, with a maximum of 48%. The latter value implies that on average the company involved has received a claim for almost two users per year. There are four enterprises with indicators above 30% that show some deficiency. Importantly, this indicator not only reflects the perception of quality of service

but also the efficiency in resolving claims. More precisely, low levels of claims may occur because there is a perception that the service is of good quality or the service may be poor but as the claims are not resolved people do not make them.

As for Argentina, the system of drinking water supply of Greater Buenos Aires is a low-pressure system and usually has storage buildings, ensuring that almost all the population has continuous drinking water service. However, during privatization, investments in production capacity for rehabilitation and renovation of infrastructure were not enough to improve water production volumes and levels of loss, as planned originally. This inefficiency resulted in low pressure problems in almost 70% of the potable water network and in sewage system overflows. Sometimes this fact affected the quality of water supplied in some areas of the conurbation, as during peak demand summer months. To maintain pressure levels required for the continuity of service, supplemental flows from groundwater were used by pumping from wells that have high levels of nitrates. This created events that exceeded the allowed limit of nitrate content.

NETWORK LOSSES

The availability of drinking water is clearly affected by network losses. That is, not all the water produced is marketed because some of it fails to reach its destination. In a sample of 41 observations in Latin America, ADERASA (2009) found average net losses around 47%. It notes estimates in the larger companies in Chile of 29% for Andean Water SA (Gran Santiago and others); 51% ESSBIO (Concepción, Rancagua, others); and 41% for ESVAL (Valparaiso and other). In the case of Greater Buenos Aires, because it only measures 12% of water consumed, the determination of the volume of water losses in the network is unreliable. But the company `subtracter AYSA estimated service is currently about 44% of produced water (water and sanitation Argentinos SA, Annual Report 2009).

For metering, the legal, regulatory and contractual basis has been defined in laws and decrees that specify technical aspects, engineering and economics to minimize the discretion of the parties. The framework, in particular the rate system based on metering and economic regulation, has appropriate incentives and signals for the wise use and management of service delivery efficiency.

The absence of metering in many countries results in consumption that is considerably higher than normal values. For example, consumption is more than 350 liters per capita per day in Panama, Dominican Republic and Venezuela, according to PAHO in 1998, a situation also prevailing in the metropolitan area of Buenos Aires. Given the existing problems of coverage in Latin America, the use of gauges could collaborate with the rationalization of consumption and free allocations of water for people without access.

ADERASA (Benchmarking, 2009) estimated the coverage of metering by the total number of household meters to total operating water connections for a sample of 50 companies in Latin America. There was wide variation in the values recorded for 2007 covered services from 100% micro-measured micro-measurement services with less than 10% and with a sample mean of 67%.

LEVELS OF INVESTMENT IN WATER AND SANITATION

While the governments of Latin American countries have made efforts to expand coverage of potable water and sanitation, deficits are widespread in the countries of the region. Historical investment levels have been below the minimum requirements to address the replacement of existing assets and population growth, the achievement of universal coverage, and compliance with higher standards of environmental quality.

There are difficulties in obtaining data about the levels of investment in the sector. Even in the cases that are available, there are problems of consistency and partial scope. Specifically, the main reasons why such information is scarce, incomplete or not available are: (a) in some countries investments to state enterprises are broken down into administrative levels with a multiplicity of actors that complicates the aggregation of figures and is aggravated by different accounting policies to record investment; (b) different procedures or criteria for allocating investment accounting (e.g. there is a very thin dividing line between the concept of renewal and rehabilitation, which is an expense, and the concept of improvement and maintenance, which is an investment); (c) the specificity of the investments can not be compared between countries, even between regions within a country; and (d) finally, international comparisons generally do not accurately reflect the magnitude of the investment because of periods of high inflation endured in the region in the last 35 years and because of the use of different currencies.

Data from some countries about the participation of sectoral investment in Gross Domestic Product (GDP) show a comparison of the efforts in this area. Notwithstanding the caveats mentioned above, with overall figures of reference one can size the level of sectoral investment and make some comparisons. In this regard, it is estimated that in the period 1990/2000 in the countries of Latin America and the Caribbean, investments were made in the amount of U$ 24,000 million (Chama, 2003). It is estimated that in 2000 the member countries of Latin America (excluding Cuba and Paraguay) invested at a cost of U$ 3,700 million. This represented 0.2% of GDP of this group of countries and 1% of total investment.

In Argentina, in 1970-1980, the national government and the provinces spent an average of U $ S 308 million and the next period from 1981 to 1991 (i.e. from decentralization to privatization), the average annual investment dropped U$ 160 million. The downward trend has been deepening sectoral investments since 1989, primarily as a result of worsening macroeconomic conditions in the country. In the period 1970-1980, the annual investment in the sector represented on average 0.17% of GDP and 0.70% of Gross Domestic Fixed Investment (GDFI) and in the period 1981-1991 these percentages fell to 0.08% of GDP and 0.46% of the GDFI. While the decline in sector investment coincides with a similar trend in total public investment, the process of decentralization of the provision deepened this fall, as the impact of that policy was not offset by provincial resources. Tariff levels by provincial lenders were not adapted to the real needs for improvement and expansion of services, so the operation became highly deficient and dependent on the provincial budget resources, including for recurrent expenditures. With these financial conditions, investment had to depend almost exclusively on provincial budgetary resources, and to a lesser extent on domestic funds or loans from multilateral agencies. Consequently, the sector investment levels were low, even to maintain and replace existing facilities.

In the period 1993-2001, characterized by significant private sector participation in providing services, there was a growing level of investment in the sector. Since the economic crisis of 2001 onward, however, the annual investment amounts were reduced dramatically. But there are plans in the works that would involve a significant increase in sectoral investments in the coming years, based on the contributions of the state budget financing and loans from multilateral banks.

AYSA has launched a greater Buenos Aires master plan for 2007-2020 to meet the needs of drinking water and sewers within the entire area of its concession, which involves an investment of about U$ 6,000 million. This includes a water treatment plant in Tigre, for two million, the expansion of water treatment facilities, scrubbers and pumping stations and a program of renovation and rehabilitation of existing networks and facilities. Launch stage is the construction of a sewage treatment plant in Berazategui for four million people and a sewage system Matanza-Riachuelo, which involves the construction of two interceptor-collecting ducts that allows flexible operation of the drainage sewer for future expansion, and the construction of a pretreatment plant and outfall for the river Plate. These investments will reasonably meet the millennium goals, reaching 90% of drinking water cobretura.

ACCESS TO SERVICES OF DRINKING WATER AND SANITATION

The investment needs identified in the previous section not only have a benefit in increasing and improving the infrastructure but also involve a redistribution of income toward low-income people. The 2006 Human Development Report developed by UNDP emphasizes that almost two in three people lacking access to clean water survive on less than U$ 2 a day, and one in three live on less than U$ 1 a day. More than 660 million people without sanitation live on U$ 2 a day and more than 385 million on less than U$ 1 a day. These facts have important public implications, because they clearly indicate the limited capacity of unserved population for adequate access to water and sanitation financed by private spending.

While it is possible to argue that the private sector can have a role to play in providing public funding, it is the key to overcoming deficits in water and sanitation. In many countries, the distribution of adequate access to water and sanitation go hand in hand with the distribution of wealth. The average of households with access to piped water is about 85% to 20% of countries with greater resources, compared with 25% in 20% of the least developed countries. The inequality goes beyond access. A perverse principle that exists in many developing countries is that the poor not only have access to less water and less clean water, but also pay higher prices because the distance from the public supply raises prices. As water passes through intermediaries and each one adds the marketing and transport costs, prices increase. The population living in slums pay five to ten times more per liter than people with more resources in the same city.

The pricing policy of public utilities is an additional problem. Currently, most utilities implement tariff schemes by block. The aim is to combine equity with efficiency by raising the price of the volume of water used. In practice, the effect is usually that the poorest households are covered by the higher prices because the intermediaries who supply water to poor households buy water in bulk at the highest rates.

Recent studies suggest that the coverage of potable water services is greater, four to 16 times, in families with higher income than those with lower income [PAHO / WHO, 2001]. A study by the IDB (“Initiative for Water Supply and Sanitation"-American Development Bank, 2004) elaborated on the basis of household surveys for the countries of Latin America. It indicates that 50 million people are without access to drinking water (70% correspond to the two lowest income quintiles) while 125 million people are without sanitation services (84% correspond to the two lowest income quintiles). Similar results were found in a recent study by UNICEF / WHO (World Health Organization and United Nations Children's Fund Joint Monitoring Programme for Water Supply and Sanitation (JMP). Progress on Drinking Water and Sanitation: Special Focus on Sanitation. UNICEF, New York and WHO, Geneva, 2008). It notes that the richest quintile of each country has an average coverage of sanitation services three times that of the poorest quintile

In urban areas, the proportion of spending for water among the poorest families is two to four times higher than among the richest families. The population has no access to adequate drinking water supply and sanitation and thus adopts alternative solutions. In the case of drinking water, these include public sources, individual wells, tankers, illegal connections to the network of public system or water catchment rivers, lakes or other water bodies without treatment. Many such solutions do not guarantee the quality of water obtained and have a high cost to the user. On the other hand, the widespread use of septic tanks and latrines has caused groundwater pollution in some cities.

There have been no adequate studies on the place of water in the budgets of poor households. What is clear is that for millions of households, the high price of water overloads the already insufficient resources. In the evidence collected in Latin America for the 2006 Human Development Report developed by UNDP, it was found that 20% of the poorest households in Argentina, El Salvador, Jamaica and Nicaragua, the costs of water represented 10% of

expenses.

About half of these households live on less than U$1 a day, the extreme poverty line (Gasparini, Leonardo, and Leopoldo Tornarolli. 2006: “Disparities in Water Pricing in Latin America and the Caribbean."). A positive relationship is noted between the rate of coverage compared to GDP per capita, with a correlation coefficient (R2) of 62%. Variance in the coverage rate should be compared to variations in the GDP per capita.

The development of sanitation services is a process of major investment over a long period. The intensity and regularity of this process of investment is conditional on the macroeconomic context.

Growth and economic stability within the framework of rational and consistent policies are conducive to good public finances, improving the ability to pay the population and providing the context for public and private investment. For this reason, it is understood that the policies and the country macroeconomic conditions have decisive impact on the development of health sector performance under both private and public provision.

Just as important as the growth of the economy is to achieve the necessary conditions for investment in health infrastructure, this condition alone is not sufficient. In fact, stable and sustained growth matters because it determines the degree of predictability of the economy and the environment for both private and public investment [Lentini, E. "Drinking Water and sanitation: lessons from relevant experiences,” 2009, ECLAC, forthcoming].

WATER AND HEALTH

The distribution of wealth generated from the universalization of potable water and sanitation not only improves the income of poor through reductions in costs associated with these services, but also improves the health and welfare of lower income people. It is estimated that in the developing world 80% of illnesses are due to the consumption of unsafe water and poor sanitary conditions ["2003 International Year of Freshwater", UNESCO, 2003].

Almost one tenth of the diseases could be prevented from an improvement in the conditions of water supply, sanitation, hygiene and water resource management. Such improvements

reduce child mortality and improve health and nutrition levels steadily. These improvements yield multiple benefits from the standpoint of economic and social well-being and indirectly by increasing the access of individuals to health-related services.

Also, improvements in water supply and sanitation services could also improve education and allow more women to attend school instead of wasting time fetching water. [Human Development Report 2006. “Beyond scarcity: Power, poverty and the global water crisis” Published for the United Nations Programme for Development (UNDP)]

Poor water quality is a major cause of poor living conditions and health problems in the world. In 2002, diarrheal diseases and malaria took the lives of approximately 3,100,000 people. Ninety percent of the deaths were children under five years old. It has been estimated that each year the lives of 1,600,000 people could be saved if they were offered the possibility to access drinking water supplies, sanitation and hygiene ["Water, a shared responsibility. Second United Nations report on the development of water resources in the world ", 2006].

In the urban household sector, special emphasis is on the lack of access to adequate quantities of safe water and adequate sanitation and hygiene promotion. Water-related diseases are a human tragedy that every year kills more than five million people. Approximately 2,300 million people suffer from water-related diseases. About 60 percent of global child mortality is caused by infectious and parasitic diseases, mostly related to water. In particular, the map below outlines by region the number of deaths associated with diarrhea problems worldwide. Sites that stand out as most vulnerable are regions of Sub-Saharan Africa and southern Asia.

The problem of diarrhea especially affects children. About 1.4 million children die each year from preventable diseases related to diarrhea. Diarrhea is one of the main factors of death among diseases related to water, sanitation and hygiene, contributing 43% of deaths in the region of Sub-Saharan Africa and South Asia.

For Latin America, the World Health Organization developed an index called WSH ("Water, Sanitation and Hygiene"), which counts the number of deaths or illnesses by unsafe water, inadequate sanitation and poor hygiene. Measurement units of this index can be two: the first is the number of deaths, and the second is the Index DALY (Disability-Adjusted Life Years),

which is determined using the years of delay or number of years lost to an early death from disease.

DALY is a measure that weights the deaths and illness from the years lost to the disease contracted. WHO defines it as a measure of the health gap that extends the concept of potential years of life lost due to premature death (Years of Potential Life Lost, PYLL) to include equivalent years of "healthy" life without disease or disability. This unit of measurement combines a measure of time lived with illness or disability and time lost due to premature death. One DALY can be thought of as a year of "good health" lost and the burden of disease as a measure of the gap between current health status and the ideal state where the individual lives into adulthood free of disease or disability. For further references see http://www.who.int/healthinfo/boddaly/en/.

In 2008 the World Health Organization (Prüss-Üstün A, Bos R, Gore F, Bartram J. “Safer water, better health: costs, benefits and sustainability of interventions to Protect and Promote Health" World Health Organization, Geneva, 2008) estimated that the percentage of diseases related to WSH for the world was 9.1% (measured in DALYs), with 10% for the least developed countries and 0.9% for developed countries. In the Latin America, the percentage of diseases related to WSH is 3.8%.

Figure N º 3 represents the indicators reported by the World Health Organization for Latin American countries in 2002, compared to the values of the coverage comparison index. The function index drawn coverage compared to the index ASH has an index of correlation (R2) of 51% of the variance in rates of ASH and can be explained by variations in the level of the coverage comparison rate.

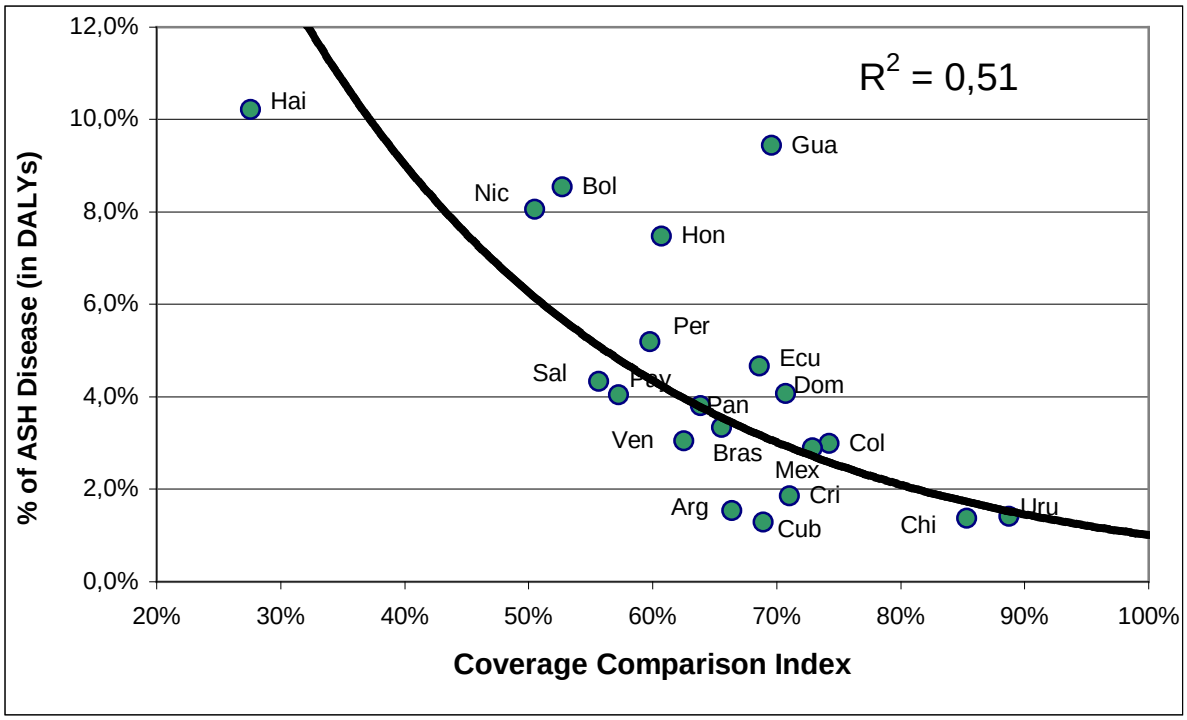

Figure Nº 3. Relationship between the percentage of ASH disease (in DALYs) and Coverage Comparison Index. Source: WHO / UNICEF: World Health Organization and United Nations Fund for Children: Joint Monitoring Programme for Water Supply and Sanitation. And World Health Organization, Geneva, 2008. [Lentini, E., "Drinking Water and sanitation: lessons from relevant experiences, 2009, ECLAC, forthcoming*]*

IMPACTS OF THE RISE OF GROUNDWATER

Over the last Century the urban macro region of Buenos Aires, Argentina (including the Buenos Aires city itself and nineteen districts) suffered an intensive demographic growth process and a concentration of economic, becoming one of the more dense urban areas in the world. This metropolitan zone has 4.000 km^2 and more than 12 millions inhabitants, one third of the total population of the whole country, and approximate one half of the Argentinean economic activities. It includes also the seat of the National Government.

Many localities of the Greater Buenos Aires urban area suffer the consequences of a disagreeable invasion of liquid coming up from the subsoil. The rise of the groundwater surface is a big problem and it requires for the attention of the local authorities and research institutions. The origins of this progressive elevation of the groundwater level are under

discussion, connected with the responsibilities of different actors. In addition, water coming from the subsoil has severe pollution conditions. Briefly, the problems associated with the uncontrolled rise of groundwater level would be: inundation of cellars (even in highlands), structural foundation problems, water outcrop in lowlands with inundated fields, cave-in of cesspools, polluted water in human contact, pavement destruction in streets and, finally a severe deterioration of the quality of life.

According to some preliminary explanations, the process can be associated with an increment of the rainfall in the region due to climate factors or associated with anthropogenic actions, as the water importation from sources placed out of the basin, the deficiency of wastewater networks, the systematic decline of the public water supply by wells from the "Puelches" aquifer and the strong decline of the domestic and industrial water wells from the unconfined aquifer. The first objective *(BIANCHI, H. & LOPARDO, R.A.: "Diagnosis and Mitigation of Groundwater Level Rise in a Highly Populated Urban System", XXX IAHR Congress, Thessaloniki, Grecia, 2003, Vol. B, , pág. 629-636*) was to identify the real factors causing the groundwater level variations, to calculate the percentage of responsibility of each variable, to determine the areas subjected to the groundwater rise problems, to produce actions on the correct information rise the awareness of the population on the subject and to propose immediate remediation activities.

For the evaluation of the actual conditions in critical zones and mitigation actions, diverse activities were developed: evaluation of existing data, diagnosis of the existing wells network action on the groundwater level, hydrological and meteorological characterization groundwater studies, mathematical modeling of the physical process, groundwater quality determinations, surface urban drainage evaluation, land type and use, sanitary risk zones identification and environmental characterization.

For the institutional coordination the following activities were programmed: contact with public institutions of different levels and private actors, institutional capacities identification, financial capacities identification, development of an institutional strategy, proposal of responsibilities and coordination officers and the formulation of an integrated plan.

In order to reach the particular and general products the following critical actions were considered: a) data analysis for the general diagnosis and the integration in a GIS, to have

rainfall data, evaporation, public water supply networks, wastewater networks, land use, location of water supply wells, water quality data, social and economic data, groundwater levels and piezometric levels, b) evaluation of the hydrological and hydraulic process to allow the description of the physical behavior of the water resources in the whole region. c) modeling of the surface water and groundwater interaction, d) preparation of regional risk maps to identify the critical regional distribution of the problem. e) environmental and economic analysis of the diverse water management alternatives, including groundwater level control, external water supply, water transfer from groundwater to surface drainage, management of water excess, protection of urban areas and environmental impact assessment.

As a study case of this general program a particular research was developed. The chosen municipality was Lomas de Zamora (Figure 4), a zone considered by the government as being in "hydrological emergency" during 2001-2002. The municipality of Lomas de Zamora, located in the southern region of the Greater Buenos Aires, has a surface area of 88 Km^2. Its population is grown 574.330 inhabitants in 1991 to 627.806 in 2001.

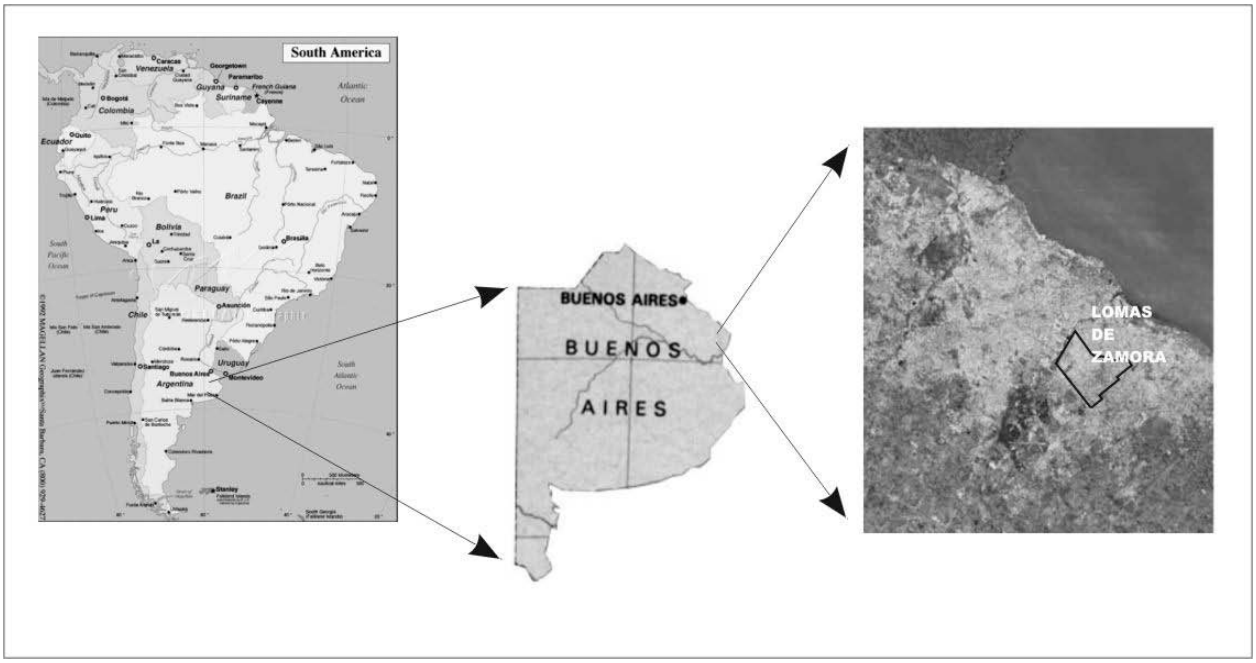

Figure Nº4

Physiographically, Lomas de Zamora is located in the lower area of the Matanza River Basin, with inefficient natural surface drainage characteristics towards the Matanza-Riachuelo

system. This aspect gives to Lomas de Zamora more vulnerability than other regions of the Buenos Aires metropolitan urban area, located at mean or high territories. The maximum level of the district is located at the south, with 25 m over the sea level and one third of the territory in below the 5 m level. The groundwater source is a complex aquifer named “Puelches”, containing a semi-confined aquifer. A layer called "Epipuelches", made up of silts with some sand layers, contains two interconnected aquifers: the lower one semi-confined (previously mentioned) and the free groundwater level.

The high population growth in the past decades was not followed by a simultaneous growth of the wastewater network infrastructure. Natural and anthropogenic factors have caused changes in that period. In 1991 the public water supply network (coming from the “Puelches” aquifer) connected a 69,9% of the population in the municipality of Lomas de Zamora, while the wastewater network connected only 22,7% of the population. Ten years later, the public water supply connected more than 90% of the population, but now the source is surface water, imported to the district by big aqueducts from the La Plata River, as a consequence of the privatization of the water supply system for the metropolitan urban area of Buenos Aires five years ago. On the other hand, the wastewater network was delayed in the timetable of the concession contract, and less than 50% of the population of the district was connected in 2001.

Other anthropogenic factors can be also considered in the analysis of this municipality, as the deforestation in the scarce rural sectors, the sharp drop in industrial activities, with less groundwater requirements from wells, and the cited change of the public water supply source. This aspect has two different impacts, both negative for the groundwater level elevation: the abandonment of big wells from the aquifer generates a growth of its piezometric levels, and at the same time, external water imported without the corresponding wastewater network and pluvial drainage infrastructure increase the soil incorporation of water.

Even if the causes of groundwater level variations are conceptually identified, the goal of the project was the quantification of their impact. This requires a particularly detailed analysis of each variable to allow its integration in a water balance and the calculation of the incidence of each variable in the general behavior of the system. The difference between the input water (precipitation and importation from external sources) and outputs (surface drainage and evapotranspiration) of the system is, in terms of water balance, the volume possible for

infiltration, which can increase the groundwater level. The magnitude of the volumetric imbalance and its effect on groundwater levels depends on the surface and underground physical characteristics of the local basin. Taking into account this conceptual framework, a specific methodology was used to reach a quantitative diagnosis in a short time (with existing data) and a mean time analysis, including new data incorporated during the project. This methodology is considered as a useful tool for the emergency measures proposal, the analysis of the actual operations and the optimization of structural and nonstructural actions to allow the final solution of the problem.

In the territory of the Lomas de Zamora district three different homogeneous zones were identified (Figure 5), taking into account topographic aspects, urbanization degree, existing infrastructure and water supply source before the service private concession.

FigureNº5

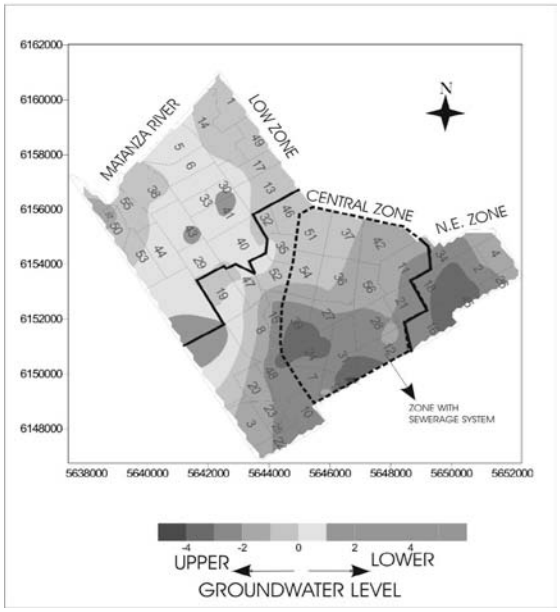

Figure Nº 6

The unconfined groundwater level variation comparison between 1992 and 2000 (Figure 6) shows firstly that a progressive rise of the groundwater level was produced along the last decade, and secondly that this rise was not uniform in all the territory of Lomas de Zamora. Even though the “Central Zone” and the “NE Zone” are the highest topographic areas of the district, with higher impermeability coefficients, surface flow and drainage infrastructure,

they have the greatest rise in unconfined groundwater levels. Due to this fact, a well network system to decrease the groundwater level was installed by the government. The third region of the district, “Low Land Zone”, near the Matanza river, where is the lower income population lives, does not have any significant variation of groundwater levels.

Due to the topographic characteristics of the Greater Buenos Aires territory, where very low slopes are present, the vertical process of recharge and discharge of the unconfined aquifer are extremely predominant over the horizontal flows, particularly in the “Central Zone” and the “NE Zone”. This conceptual hypothesis was determinant for the quantification of the diverse processes affected by natural and anthropogenic factors causing groundwater rise.
From the total water volume coming to the unconfined aquifer during the analyzed period (1991-2001) around 50% has anthropogenic origin. Considering the natural factors, a decrease of 5% of the water infiltration in the soil was detected for the period 1995-2001 (120.2 Hm^3) relative to the period 1991-1995 (126.2 Hm^3). Despite the fact that precipitation increased in the Buenos Aires region during the period of the study, the decrease in infiltration over the same period balanced the system (Figure 7).

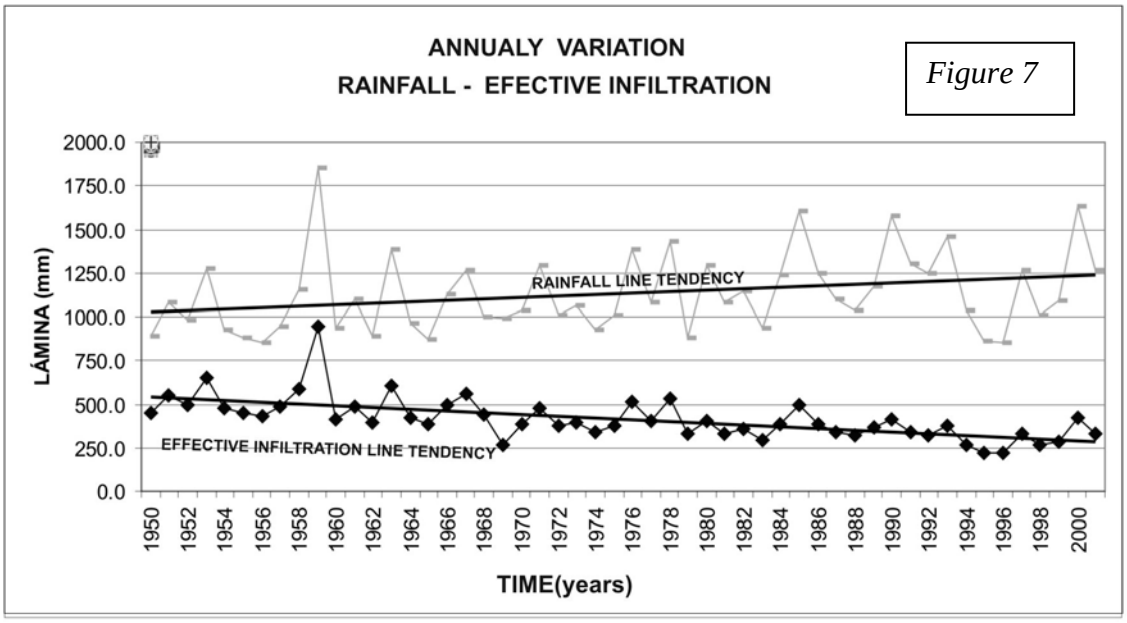

Figure 7

The anthropogenic water inputs were substantially higher along the period 1996-2000 than the water inputs during the period 1991-1995, increasing around 35%. The rise of water inputs due to anthropogenic factors is more important in the “NE Zone” (56 %) than the “Central Zone” (35%) and the “Low Land Zone” (20%). This anomaly can be explained because the “NE Zone” has the maximum increase of the public water supply network (271

% in that period). In the three zones, for both periods, the anthropogenic factor with the greatest impact is the polluted input from cesspools.

It is possible that the evapotranspiration effect can have some variation during the period of analysis due to the population growth, but the order of magnitude detected on this subject is not important for the present study. The natural surface flow to the rivers, with particular interest for the “Low Land Zone” towards the Matanza River and for the “NE Zone” towards the Las Perdices Stream, were also analyzed, but they did not have any significant changes during the period of study either. Therefore, their influence on the groundwater level variation in Lomas de Zamora can be neglected.In short, variations of the water table had different causes and degree of impact, depending on their geographical location.

At the same time, the behavior of the water table associated within those locations is distinguished by different patterns of performance, influenced by topographic characteristics, degree of urbanization, drilling (for both drinking water and for industry), importation of water, development and age of potable water networks, sewage and rain water. These features led to the creation of a new concept. It enabled orderly treatment of the problem, which was defined as homogeneous areas. The aim is the identification of areas or areas where vertical movements (recharge or discharge) of the water table are made from the domination of one specific factor, whether natural or anthropogenic. On the lower slopes where the metropolitan area is developed, the vertical movements are dominant over the horizontal flows.

CONCLUSIONS AND RECOMMENDATIONS

The countries of Latin America in general, and Argentina in particular, show a remarkable concentration of population in urban areas. The poorest live in the outlying areas of large cities, with very little or no land use planning. This leads to a high vulnerability to water risk factors, both excess water (floods), defect (lack of provision of safe water) or poor quality (pollution of surface and underground water courses). The costs of providing increases as connections are made longer. And there are problems of competency in jurisdictions (nation, province, municipality).

To ensure service quality, it is necessary to make rigorous checks on an ongoing basis and throughout the water cycle. These quality controls should cover all stages of the process. It

should start with raw water, continue through processing steps and output of water treatment facilities, and continue throughout the distribution system. The cycle must be completed by controlling the liquid waste to sewer dumps, as well as the effluent at treatment plants before discharge.

It should focus on the needs of those who still have no service and are in socio-economic difficulties through the development of flexible forms, the search for innovation, and adaptation of management. Therefore, people in the urban centers must help and promote cooperatives, which have proven to be efficient providers of water service and sewage in several cities in Argentina.

On the other hand, it is important to note that AYSA has had considerable success doing specific work with lower income sectors, through the methods of "participatory models of governance" (MPG) and the “Water+Work Plan” (Plan agua más trabajo) and to a lesser extent to “Sanitation+Work Plan”, which is reflected by joint action with neighborhood communities, municipalities, government agencies and social organizations. This is a strategy based on joint work-sharing and community sites to serve the municipalities and the company involved that is aimed at improving access of water and wastewater services to the population living in slums. It should be noted that the Water+Work Plan was awarded the Latin American and Caribbean Priza for Water, Plate Business 2008 by the Center for the Humid Tropics of Latin America and the Caribbean in partnership with CARE USA, UNICEF, UNEP and other institutions.

It should take into account the possible impacts that a water supply from a source outside the basin may have on groundwater levels, and anticipate any risks of contaminated water upgrades on the quality life of the inhabitants.